

Midterm Exam

Relational Languages: Relational Algebra, Datalog & SQL

Consider the following schema:

Coffee(cbrand, producer)

CoffeeShop(sname, addr)

Sells(sname, cbrand, price)

Attributes cbrand and producer in relation Coffee are names and producers of coffee brands, respectively. Attributes sname and addr in relation CoffeeShop contain the names and addresses of coffee shops. The relation Sells stores the price at which coffee shops sell different brands of coffee. The underlined attributes are the keys for their relations.

- a. (3 points) Write a relational algebra (RA) query that returns the address of every coffee shop that sells the brand 'Coava'. 'Coava' is a brand of coffee.

SQL:

```
SELECT cs.addr FROM CoffeeShop cs
JOIN Sells s ON cs.sname = s.sname
WHERE s.cbrand = "Coava"
```

RA:

$$\pi_{addr}(\sigma_{cbrand="Coava"}(Sells) \bowtie CoffeeShop)$$

- b. (3 points) Write a Datalog query that returns the address of every coffee shop that sells only the brand 'Coava'. 'Coava' is a brand of coffee.

DL:

ShopsNoCoava(sname) :- Sells(sname, cbrand, _), cbrand != "Coava"

ShopsInverse(sname) :- Sells(sname, "Coava", _), not ShopsNoCoava(sname)

OnlyCoava(addr) :- ShopsInverse(sname), CoffeeShop(sname, addr)

- c. (2 points) Write a SQL query that returns each producer that makes the most expensive brand(s) of coffee, i.e., coffee brand(s) sold at the highest price.

SQL:

```
SELECT c.producer FROM Coffee c
JOIN Sells s ON c.cbrand = s.cbrand
WHERE s.price = (
    SELECT MAX(price) FROM Sells
)
```

- d. (2 points) Write a SQL query that returns the address of each coffee shop that sells every brand in the Coffee relation.

```
SQL:
SELECT cs.addr FROM CoffeeShop cs
JOIN Sells s ON cs.sname = s.sname
GROUP BY cs.sname, cs.addr
HAVING COUNT(DISTINCT s.cbrand) = (SELECT COUNT(*) FROM
Coffee)
```

- e. (3 points) Write a SQL query that returns the addresses of every pair of coffee shops that sell the same set of coffee brands.

```
SQL:

SELECT cs1.addr, cs2.addr FROM CoffeeShop cs1
JOIN CoffeeShop cs2 ON cs1.sname < cs2.sname
WHERE NOT EXISTS (
    SELECT cbrand FROM Sells s
    WHERE s.sname = cs1.sname EXCEPT
    SELECT cbrand FROM Sells s
    WHERE s.sname = cs2.sname
)
AND NOT EXISTS (
    SELECT cbrand FROM Sells s
    WHERE s.sname = cs2.sname EXCEPT
    SELECT cbrand FROM Sells s
    WHERE s.sname = cs1.sname
)
```

- f. (2 points) Write a SQL query that returns the address of every coffee shop that sells only the brand 'Coava'. 'Coava' is a brand of coffee.

```
SQL:
SELECT cs.addr FROM CoffeeShop cs
WHERE cs.sname IN (
    SELECT s.sname FROM Sells s
    WHERE s.cbrand = "Coava"
)
AND cs.sname NOT IN (
    SELECT s.sname FROM Sells s
    WHERE s.cbrand != "Coava"
)
```